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West Fork
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PRELIMINARY ENVIRONMENTAL REVIEW

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MINERAL EXPLORATION ADIT

JOHNS-MANVILLE SALES CORPORATION

WEST FORK STILLWATER RIVER

SWEET GRASS COUNTY, MONTANA

PLEASE RETURN

COMPILED BY: M. K. BOTZ
WATER QUALITY BUREAU
ENVIRONMENTAL SCIENCES DIVISION
DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

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PRELIMINARY ENVIRONMENTAL REVIEW

Mineral Exploration Adit
Johns-Manville Sales Corporation
West Fork Stillwater River
Sweet Grass County, Montana

The Johns-Manville Sales Corporation (J-M), after encountering substantial water in their exploration adit, applied on February 13, 1976 for a waste discharge permit to the Montana Department of Health and Environmental Sciences, Water Quality Bureau. The application for a permit is pursuant to Section 69-4806, R.C.M. 1947, and Rule MAC 16-2.14 (10)-S14460. The Montana Environmental Policy Act, Title 69, Chapter 65, R.C.M. 1947, requires the Department of Health and Environmental Sciences to prepare an EIS (environmental impact statement) on major actions of the Department that will significantly affect the human environment. A determination of whether the Department's decision on J-M's permit application will have such a significant impact on the human environment is to be determined through the preparation of a preliminary environmental review (PER) in accordance with rule MAC 16-2.2(2)-P2020 and -P2030. This PER constitutes the Department's analysis of the projected impact of the Department's decision to issue or deny an MPDES permit to J-M and contains a recommendation concerning the need for the preparation of an EIS. Developments leading to the J-M exploration adit are described in the U. S. District Court Memorandum and Order (Friends of the Earth, Inc. vs. Earl L. Butz, 1975),

> "JMSC has been actively exploring since 1967 for minerals of economic value in the Stillwater complex, and started staking mining claims in 1968, with exploration drilling commencing in 1969. During the winter of 1970-71, JMSC began working with the Forest Service on various aspects of this overall exploratory project. Meetings before the Forest Service and JMSC led to a set of guidelines on mineral exploration in the Custer and Gallatin National Forests, issued in April 1971. During the winter of 1970-71, the Forest Service, the United States Geological Survey, the Montana Department of Fish and Game, and the Montana Department of Health, in cooperation with JMSC and other mining companies, prepared a draft interagency proposal regarding water quality monitoring in the Stillwater complex. Further, in July 1971, JMSC, the Forest Service and the Montana Department of Fish and Game jointly adopted reclamation guidelines with respect to mining exploration in the complex."
>
> "Then, on August 28, 1974, the Forest Service issued regulations effective September 1, 1974, establishing an entirely new system for control by the Forest Service of prospecting and mining activities on national forest lands...."
>
> "Under the new regulations, the Forest Service examined JMSC's proposed prospecting activities to determine whether they would have adverse environmental consequences and approved a plan of operations."

The Montana Department of State Lands issued an exploration permit to the J-M Sales Corporation on May 3, 1972. The permit was renewed on April 28, 1976 for a one-year period.

II. DESCRIPTION OF PROPOSED ACTION

Section 69-4806 states in part: "It is unlawful to:

(2) carry on any of the following activities without a current permit from the Department;

(a) construct, modify, or operate a disposal system which discharges to any state waters;

(b) construct or use any outlet for discharge of sewage, industrial waste, or other waste to state waters; or

(c) discharge sewage, industrial waste, or other waste into any state waters; or..."

On January 18, 1974, the Board of Health and Environmental Sciences adopted a rule, MAC 16-2.14(10)-S14460, entitled the Montana Pollutant Discharge Elimination System (MPDES). This rule provided program elements needed by the state to administer a waste discharge permit program in the state of Montana. Section 4 of MAC 16-2.14(10)-S14460 states in part:

(c) "The owner or operator of any proposed point source, which may discharge pollutants into state waters, shall file a completed MPDES permit application no less than 180 days prior to the day on which it is desired to commence operation of the point source..."

Johns-Manville Sales Corporation (J-M), on February 13, 1976, applied to the Department of Health and Environmental Sciences for an MPDES permit to discharge mine drainage water to the West Fork Stillwater River. The application covers only discharges which may occur during the exploration phase. The application indicates an expected discharge in the range of 60,000 gallons per day to 900,000 gallons per day. The application also states, in part: "Exploration activity with unpredictable flow - all water is naturally occurring water percolating through underground rock which was unexpectedly encountered in a dike contact zone."

The original application was determined by the Department to be incomplete. In a letter of April 22, 1976, the Department requested additional information. On May 19, 1976, "J-M" responded to the Department's request and provided the requested additional information.

The Department has information relative to the quality and quantity of the drainage from the mine adit, (Table 1). These data are from

various organizations including, the Montana Department of Fish and Game, the Water Quality Bureau of the Montana Department of Health and Environmental Sciences, and the Johns-Manville Sales Corporation. It should be noted that the Department believes some data summarized on Table I is not accurate; that is, proper sample preservation techniques may not have been followed in all cases.

III. DESCRIPTION OF J-M PROJECT

The following description of the J-M project is taken from the Federal EAR (Environmental Analysis Report) written by the U. S. Forest Service (1974).

> "Johns-Manville Sales Corporation proposes to drive a 3,000-foot exploration adit at 6,500-foot elevation adjacent to the West Fork of the Stillwater River, near the center of the W½, Section 14, Township 5 South, Range 14 East (unsurveyed). The purpose of the adit is to obtain bulk samples of the ore to determine its quality and characteristics.
>
> In order to achieve this purpose, the following actions are needed:
>
> 1. Approximately 6.0 miles of the West Fork Stillwater Road will need spot stabilization and additional culverts before ore trucks can safely haul the bulk sample. Two cattle guards may require replacement with heavier duty materials.
>
> 2. A 50-foot bridge will be constructed across the West Fork of the Stillwater River.
>
> 3. A campsite location will be needed for housing the crew near the adit. Facilities will be two bunkhouse trailers, one cookhouse trailer, one office trailer, one washroom-showerhouse, vault toilets, water system, and septic system with drainfield.
>
> 4. Approximately 300 feet of new road for access to the adit portal.
>
> 5. A location, near the adit, for a 1,500 square foot building to be used as a combination compressor house, garage, repair shop, and laboratory. This building will have shower and toilet facilities plus water and septic system.
>
> 6. Area near adit portal for storage of approximately 4,000 cubic yards of rock to be mined. Approximately 1,000 yards will be ore and 3,000 yards will be waste."
>
> "Johns-Manville has been actively exploring in the Stillwater Complex for minerals of economic value since August 1967. The methods of exploration involve geologic mapping, geophysical, and diamond core drilling. This exploration work has shown a potentially economic mineralized zone. In order to properly evaluate the zone, a bulk sample of ore is needed. The proposed adit is the only logical way to secure the bulk sample."

"The Johns-Manville objective is to evaluate the mineralized zone and determine if the mineral can be economically produced."

Recent communication with the J-M Sales Corporation (Tom Micklejohn, May 13, 1976) showed that Items 1 through 5 above have been completed at the site. The following additional work items have been proposed for the site.

1. The J-M Sales Corporation proposed to extend the adit 3,000 additional feet at the 6,500 foot level in accordance with D. L. Monroe's request to George P. Schaller, District Ranger, U. S. Forest Service, by letters of 12-18-75. The U. S. Forest Service is in the process of preparation of supplemental report to EAR on this subject.

2. An area near the adit portal is needed for storage of 8,000 to 10,000 cubic yards of waste rock removed during the proposed 3,000 foot extension of the adit.

IV. IMPACT SUMMARY - PHYSICAL ENVIRONMENT

Additional exploration work by the Johns-Manville Sales Corporation on the West Fork of the Stillwater River will have an impact on the physical environment. The impacts (Figure 1) range from moderate to none. Impacts that are considered minor are water quantity and distribution (the Johns-Manville Corporation will add a small additional amount of water to the West Fork of the Stillwater River); water quality - the Johns-Manville Corporation will add water of a somewhat different chemical composition to the West Fork of the Stillwater River, but will create no measurable change in the quality of the stream and will not effect the prescribed beneficial uses of the stream. There will be a minor impact on soils and vegetation in the area resulting from the additional waste rock from the adit which will cover an additional area. Continued adit activity will impact to a minor extent the limited natural resource of a high quality outdoor area. Based on information developed by the Montana Fish and Game Department, movement of elk has been altered by the J-M activities to date. This interruption of the elk movement patterns will probably continue for the duration of the additional exploration activities.

FIGURE 1

PHYSICAL ENVIRONMENT IMPACT SUMMARY

	Major	Moderate	Minor	None	Unknown	Discussion on page
Terrestrial Life & Habitats		X				5
Water Quantity and Distribution			X			6
Water Quality				X		9
Aquatic Life and Habitats				X		12
Geology and Soils			X			14
Vegetation			X			14

	Major	Mod-erate	Minor	None	Un-known	Discussion on page
Air Quality				X		16
Historical and Archaeological				X		16
Environmental Resources			X			17

TERRESTRIAL LIFE AND HABITATS

The impact of the exploration adit on the areas wildlife was described in Montana Outdoors (1976).

> "The Johns-Manville exploration adit provided an opportunity to assess the effect of a relatively minor operation on the wildlife populations. (The adit is situated along the West Fork of the Stillwater River, upstream from the mouth of Cathedral Creek.) The FS campground at Initial Creek was used for a base camp and the road across Horseman Flats (FS Road No. 846) serviced both the adit and the camp. This road also bisects an important portion of the elk winter range. Previously, the road was closed to vehicle traffic by drifting snow, but in 1974-75, the mining company kept the road plowed throughout the winter."
>
> "The Montana Department of Fish and Game recommended the following travel restrictions: minimizing trips, restricting vehicles to established roads and limiting travel to one hour after sunrise to one hour before sunset. In addition, the FS closed the road to the general public. But these restrictions weren't closely followed."
>
> Elk extensively used Horseman Flats during the winters of 1971-74. However, in 1974-75, very few elk used the flats. Elk previously moved between Horseman Flats and the Picket Pin area during most of the winter. In late spring (April and May), a portion of the herd moved to the steep east-facing slopes of Horseman Flats above the Stillwater River. After the 1974 hunting season, most of the herd was on the Picket Pin portion of the winter range, where it stayed until late January 1975, then moved to Horseman Flats. It remained on the flats for only three or four days and then appeared on the slopes above the Stillwater River and used this area for the remainder of the winter. Elk definitely avoided the Horseman Flats area in 1974-75 -- the first year Johns-Manville kept the road open all winter."
>
> "Some observers suggested that heavier snow packs in 1974-75 caused this shift in the elk winter range patterns. However, the snow was not excessive and domestic horses wintered on the flats without supplemental feed. In fact, the shift in elk use was probably due to a combination of traffic on the road and deeper than normal snow. Elk used the timbered slopes above the road for bedding and, particularly during periods of heavy snow, crossed the road and ventured out onto the open flats for feeding. Road traffic disrupted

this pattern and probably caused elk to move elsewhere. This is supported by the fact that in June -- when snow was no longer a factor -- few elk used the flats. They remained above the road for both feeding and bedding."

"Horseman Flats is also an important elk calving ground and researchers found that fewer elk calved here in 1975 than in 1974."

"The adit also affected elk migration to the summer range. The 1974 information indicated the West Fork of the Stillwater River was a major migration route, with about 57% of the winter herd using this route. In addition, elk may have calved in the West Fork area. In 1975, researchers saw only one cow above the adit during the calving season and only 27% of the winter herd used this migration route. Most of the elk shifted to the Picket Pin Creek route. Although normal patterns were disrupted, elk bypassed the mining activity and reached their summer range...."

WATER QUANTITY AND DISTRIBUTION

The basic hydrology of the Stillwater River area has been described by Leaf and Jones (1975):

Streamflow

"Table 1 is a regional summary of the streamflow characteristics of 13 drainage basins which vary from 51.1 to 11,795 square miles in size. Runoff is generally lowest in January through March and highest in May, June, or July. Approximately 75 percent of the annual flow occurs during the snow-melt runoff season (April-July), and, as previously discussed, rainfall during peak snowmelt can produce extreme flooding. Subsequent rainfall during summer and fall does not produce significant quantities of streamflow. Figure 1, reproduced from Botz (1971), shows monthly flow characteristics of streams in the Stillwater Complex.

Farnes (1971) determined that several drainage basin characteristics in the Stillwater Complex determine streamflow. Some of these parameters are area, forest cover, mean elevation, mean annual precipitation, and soil storage index. The correlation of runoff with one of the above parameters; i.e., area is shown in Figure 2 for the streams of Table 1.

Low flows. Of particular environmental concern are the extremely low flows which routinely occur during winter. As previously discussed, flow regime is the product of climatic and physiographic factors. Watersheds in the subalpine zone of the Stillwater Complex are typically covered with coniferous forests to timberline at about 9,500 feet. Soils decrease in depth with increasing elevation, thus limiting the amount of moisture that can be stored in the soil mantle. Moderate water consumption by vegetation on shallow mountain soils coupled with the tight granitic bedrock at or very near the ground surface over most of the area precludes any significant sub-surface runoff. Moreover, the lakes, ponds, and swampy

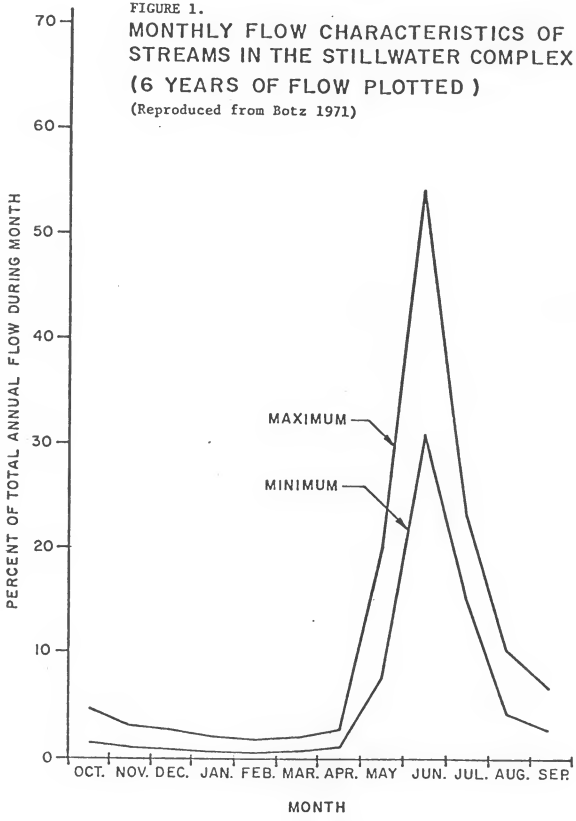
Table 1.

REGIONAL STREAMFLOW ANALYSIS

Station Number 1/	Station Name	Location S T R	Record	Area (sq.mi.)	Max. flow / Min. flow (cfs) Date	Peak (cfs/sq.mi.)	Average flow (cfs) (AF)	Yrs.	Average (AF/sq.mi.)
06188000	Lamar River near Tower Falls Ranger Station	0.5 mi. upatream from mouth	1923-69	660	13600 5-1928 40 3-1925	20.6	829 600,600	46	910
06197500	Boulder River nr Contact, Mont.	23 3S 12E	1910-12 1913-16 1929 1950-69 1970-73	226	5590 6-23-71 4.2 2-1961	24.7	380 275,300	24	1218
06199000	Weat Fork, Boulder R. at McLeod, Mont.	16 2S 13E	1907-14	135	1990 6-3-09 not determined	14.7	- 137,000	3	1014
06200000	Boulder R. at Big Timber, Mont.	14 1N 14E	1947-53 1953-73	523	9840 5-28-56 10 8-26-61	18.8	602 436,100	24	834
06202600	Stillwater River at Nye, Mont.	31 4S 16E	1969-73	337	6390 6-28-70 23 3-2-71	19.0	- 407,950	4	1210
06204050	Weat Rosebud nr Roscoe, Mont.	10 7S 16E	1965-73	52.1	1470 6-28-70 2.5 4-1967	28.1	129 93,460	8	1794
06204500	Rosebud Creek nr Absarokee, Mont.	13 4S 18E	1935-69	394	5790 6-15-67 31 5-25-36	14.7	407 294,900	34	749
06205000	Stillwater River nr Absarokee	28 3S 19E	1910-14 1935-73	975	12000 6-15-67 58 4-1936	12.3	952 689,700	38	707
06205500	Clarks Fork Yellowatone R. ab Squaw Cr. nr Painter, Wyo.	34 57N 106W	1946-51	194	4920 6-22-50 not determined	25.4	420 304,100	6	1567
06206000	Clarks Fork Yellowstone R. below Crandall Cr. near Painter, Wyo.	1 56N 106W	1930-32 1950-57	446	7850 6-4-57 not determined	17.6	not determined no winter flows	-	-
06207500	Clarks Fork Yellowatone R. near Belfrey, Mont.	31 9S 22E	1921-73	1154	10900 5-26-28 32 4-26-61	9.5	944 683,900	52	593
06209500	Rock Creek nr Red Lodge Mont.	20 8S 20E	1932 1934-73	124	3110 6-4-57 14 11-1954	25.1	172 124,600	39	1005
06214500	Yellowstone River at Billings	34 1N 26E	1904-05 1928-73	11795	f6100 6-1967 430 12-1932	5.6	6862 4,972,000	45	421

1/USGS, WSP

FIGURE 1.
MONTHLY FLOW CHARACTERISTICS OF STREAMS IN THE STILLWATER COMPLEX AREA.
(6 YEARS OF FLOW PLOTTED)
(Reproduced from Botz 1971)



areas, while providing some storage, are not extensive enough to regulate stream flow. The net result is flashy, sharp peaked, high intensity runoff during spring with rapid recession of flows to extremely low levels in late winter."

The only stream impacted by the J-M exploration adit is the West Fork of the Stillwater River. Hydrologic characteristics of the West Fork have been described previously. Average annual flow of the West Fork River is approximately 110 cfs (Leaf and Jones, 1975) and annual minimum flows are approximately 5 to 10 cfs during the months of November through February. The impact of the adit on the West Fork of the Stillwater River near the adit is to add water to the river. It is anticipated for the remainder of the exploration adit that water flows to the river will be less than 300 gallons per minute. The project has no other impact on water quantity in this stream.

WATER QUALITY

Chemical quality of the West Fork Stillwater River above the Johns-Manville exploratory adit, and of the adit discharge are summarized in Table 1. This table includes analyses performed between 75-1-7 and 76-3-8 by the Montana Bureau of Mines and Geology; a private laboratory in Billings, and the Montana Water Quality Bureau.

The West Fork Stillwater River has high quality water with very low concentrations of metals, nitrogen and phosphorus compounds, and relatively low concentrations of all other dissolved constituents. Biota present in the stream are acclimatized to these very low metal concentrations, thus they would be sensitive to introduced metals particularly in view of the low hardness of the stream water which makes most metals more toxic. (McKee and Wolf, 1973). The stream has little buffering capacity because of its low alkalinity; thus, introduced acids would have a large effect on the stream pH.

The stream has low concentrations of nitrogen and phosphorus compounds; thus, any increase in these compounds could cause significant increases in productivity and could conceivably cause objectionable algal growths. Objectionable growths of algae have occurred in other localities at nitrate-nitrogen concentrations of 0.31 mg/l and total phosphorus concentrations of 0.04 mg/l (Fast and Horpestad, 1972). Algal assays performed by the Montana Water Quality Bureau, Department of Health and Environmental Sciences, indicate algal growths may be increased three to six times at concentrations of 0.01 mg/l phosphorus (background levels were 0.002 to 0.005 mg/l phosphorus), but showed no increased growth at nitrogen concentrations of 0.5 mg/l (background levels were 0.04 to 0.09 mg/l). When both nitrogen and phosphorus concentrations were increased, the growth response was proportional to the increase in phosphorus up to levels of 0.01 mg/l. Above this point, increased nitrogen caused increased growth.

Water from the adit (Table 1) contains significantly more dissolved substances and tends to slightly increase alkalinity and hardness of the stream. This water also contains small amounts of some metals.

TABLE 1

CHEMICAL CHARACTERISTICS OF WEST FORK STILLWATER ABOVE ADIT AND OF THE ADIT DISCHARGE WATER

(all parameters in mg/l unless noted)

	Above adit (From 1/7/75 to 3/8/76)					Adit discharge**					
	$\bar{X}$	Min.	Max.	S	N	$\bar{X}$	Min.	Max.	S	N	Date(s) of measurement
Calcium	7.6	3.6	10.1	2.4	13	53	4	13.0	40.5	11	6/21/75-1/22/76
Magnesium	3.3	1.6	4.9	1.2	13	14.73	2	39	12.3	11	
Sodium	1.5	0.9	2.0	0.4	13	40.005	25	96.4	15.12	11	
Potassium	1.0	0.6	1.2	0.2	13	1.63	0.5	3.3	0.85	11	
Iron						0.08	<0.01	0.36	0.09	16*	1/26/76-4/12/76
Manganese						0.08	0.07	0.11	0.02	11	
Silicon dioxide	6.7	4.1	8.6	1.3	13	10.30	8.3	14.3	3.46	11	
Bicarbonate	35.1	23	48	9.6	13	134.49	65	171	37.80	11	
Carbonate											
Chloride	0.7	0	1.8	0.5	13	8.24	2	28	7.64	11	
Sulfate	6.73	3.4	10	2.4	13	53.01	22	71	28.20	11	
Fluorine											
Nitrate-nitrogen	0.10	0.04	0.27	0.067	12	13.35	0.23	71	20.76	25	2/18/75-4/12/76
Nitrate-nitrite-nitrogen	0.08	0.06	0.09	0.014	5	6.21	0.19	20	8.12	5	1/28/76-2/20/76
Phosphate-phosphorus	0.0026	0.002	0.003	0.0005	5	0.004	0.002	0.006	0.002	4	2/7/76-2/20/76
Total Phosphorus	0.0032	0.002	0.006	0.0016	5	0.0088	0.002	0.020	0.008	4	2/7/76-2/20/76
Totol Kjeldahl Nitrogen	0.09	<0.005	0.30	0.113	5	4.39	0.10	16	6.6	5	1/28/76-2/20/76
Ammonium nitrogen	0.01	0.002	0.04	0.02	5	26.92	0.08	82	28	5	1/28/76-2/20/76
Cadmium			<0.01		10*						
Copper			<0.01		10*	0.02	<0.02	0.05	0.017	16*	1/26/76
Nickel			<0.01		10*	0.003	<0.05	0.05	0.013	16*	
Zinc			<0.01		10*						4/12/76
Total recoverable aluminum	0.08	<0.05	0.30	0.1	7	0.22	<0.5	0.48	0.16	16*	
Lab pH											
Total dissolved solids	58.1	37.7	78.6	15.9	12						
Specific conductance (µmhos)	71.1	35.2	97.4	22.1	12						
Total hardness	31.7	15	44	10.6	12						
Total alkalinity as $CaCO_3$	28.6	19	38	8.0	12						

$\bar{X}$ = arithmetric mean
N = number of analyses

S = standard deviation
* = form not specified
** = more analyses have been made, but results are not included here.

This water also contained significant amounts of nitrogen (probably derived from blasting compounds) when exploration was occurring. A mixture of ammonium nitrate and diesel fuel was being used for blasting until shortly before work stopped. When this mixture is wetted, it rapidly dissolves and releases both ammonia and nitrate. Nitrogen enters the water both from spilled powder and from blasting residue. Just before blasting stopped, Iremite (product of Ireco Chemicals Company) was used for blasting. This compound should release significantly less nitrogen to the discharge water.

Since exploration has stopped, the nitrate levels in the discharge water have been dropping and have reached levels only slightly above background levels by May 1976 (minimum value in Table I).

If the conditions of the J-M waste discharge permit are met, there should be no measurable change in aquatic organisms in the West Fork Stillwater River and no effect on prescribed beneficial uses of water from the stream. The J-M discharge may cause small increases in the load of some dissolved constituents in the West Fork of the Stillwater River. At extremely low river flows, some of the increases in dissolved minerals may be measurable, but at normal flows, there will be no measurable change in dissolved constiuents in the stream.

If conditions of the J-M waste discharge permit are met, water quality of the West Fork of the Stillwater River will be maintained at its present high quality.

There are two other potential impacts from the planned adit development. These are the possibility of encountering toxic water in the adit and the possible development of a long-term acid mine drainage problem.

The Stillwater Complex has unique geological and mineralogical characteristics (Fuchs and Rose, 1974 and Cabri and LaFlamme, 1974). Water in contact with minerals in the complex has entered streams for ages both from surface runoff and groundwater flow. No problems of toxicity from these inflows are known. Exposure of some minerals, particularly sulfide minerals, by mining can cause formation of acid waters due to the reaction of air with water and certain minerals. This reaction is well understood for some sulfide minerals, but it has not been investigated for many other minerals. Acid mine waters are a problem in many parts of the U. S. and in Montana. The problem lasts virtually indefinitely and typically is very difficult to economically control. Many miles of stream in Montana are severely damaged by acid waters from old coal and hardrock mines.

A theoretical approach to predicting the possibility of acid mine water formation involves mineral stability diagrams and dissolution kinetics. This approach is very difficult due to lack of knowledge of stability and kinetics of many minerals.

Another approach to this problem is to examine waters from other mines in similar geological conditions and determine the quality of water in or flowing from the mine. There are no known mines in the Stillwater Complex in the same stratigraphic horizon as the J-M adit. The mine most similar to the J-M adit is the inactive chrome mine near Mouat,

Montana. No problems of acid mine water are known from this mine.

Although it cannot be substantiated with a rigorous technical proof, it appears that there is a very low probability of producing acid mine water from the additional J-M adit work. The proposed waste discharge permit includes a provision for sealing the adit in the event bad waters are encountered or are created in the adit. Sealing the mine would prevent formation and discharge of acid waters.

Another concern at the J-M adit is the possibility of encountering toxic waters. The possible presence of a natural "body" of underground water containing toxic concentrations of some element or combination of elements cannot be ignored. Several lines of reasoning, however, suggest this is very improbable. No known natural underground toxic waters are known in the area. Water encountered in the adit is part of a natural regional groundwater system and has entered streams and springs in the area for hundreds or thousands of years. No toxic water problems are known in the Stillwater Complex. The presence of naturally "toxic" groundwater is not unique, but is rare. General geochemistry and climatic conditions associated with the Stillwter Complex are basically not conducive to formation of toxic waters.

Water encountered in the adit will be monitored using bioassays before release to the groundwater system. The technique of drilling test holes in advance of the adit face will allow testing of waters before they are encountered by the adit. Water zones containing toxic waters can be grouted and sealed off from the adit before the adit is advanced into the water-bearing zone. The probability of encountering toxic waters is very low, but the contingency of a water-tight seal for the mine would prevent damage to the river if no other water control or treatment is possible. Compliance with discharge permit conditions and available water control and testing technology will avoid adverse impacts of toxic waters.

AQUATIC LIFE AND HABITATS

The West Fork of the Stillwater River is a high quality mountain stream characterized by steep gradients and a bottom composed of rubble and boulders. As the West Fork approaches the Stillwater River, the character of the stream is changed to some extent by a decreased gradient and the entry of Castle Creek which is a large, warm tributary that enters the West Fork approximately three miles upstream from the mouth. Hydrologic characteristics of the West Fork of the Stillwater (described in a previous section) is that of a high mountain stream with a short period of high flow during the spring runoff period and a relatively stable base flow during the remainder of the year.

Only three fish species are present in the West Fork. These are rainbow trout, brown trout, and mountain whitefish. Whitefish are found in small numbers only in the lower five or six miles of the West Fork, and they apparently do not reproduce to any extent in the West Fork. Brown trout occur in the West Fork from the mouth to a point approximately one-half mile below the adit. The Brown trout standing crop is moderately high downstream of Castle Creek, and decreases upstream.

Brown trout spawn in shallow areas in November with eggs hatching the following spring. The fry leave the gravel environment and move into shallow, slow pools at the stream margins. The older fish utilize faster waters and are especially dependent on undercut banks, deep pools, and pockets behind boulders. Growth rates are moderate downstream of Castle Creek and slow at upstream locations.

Rainbow trout are present in the West Fork from the mouth to at least several miles upstream from the adit. Near the adit and upstream for at least five miles, it is the only fish species present. The standing crop is moderately high in the lower few miles of the West Fork and decreases upstream. Growth rates are moderate below Castle Creek and quite slow at upstream locations, where fish reach total lengths of only two inches after the first summer's growth. At least four to five years are required to produce a fish of 10 inches total length. Rainbow spawn in spring, hatch in July, and swim actively later in the summer. Both brown and rainbow trout species are sedentary in the West Fork and they do not appear to move any great distances.

Stream bottom communities are dominated by aquatic insect nymphs and larvae. The orders Plecoptera (stoneflies), Tricoptera (caddis flies) and Ephemeroptera (mayflies) are the most abundant organisms. Small aquatic annelid worms also are present in significant numbers. These worms are increasingly abundant in a downstream direction. Aquatic insects present are largely fast water organisms living on undersides and margins of gravel, rubble, and boulders. The orders Plecoptera, Tricoptera and Ephemeroptera are considered clean water forms and they are sensitive to most pollutants. Aquatic invertebrates are nourished largely by algae and terrestrial detritus.

There are few vascular plants in the West Fork Stillwater River. The bulk of the aquatic plant communities consist of incrusting microscopic and filamentous algae. These are largely fast-water forms growing on gravel, rubble and boulders.

Potential contaminants from the J-M adit in the West Fork Stillwater River include ammonia, nutrients (nitrogen and phosphorus), and toxic metals. Acute toxicity of ammonia to fish and aquatic insects can occur at levels as low as 0.2 to 0.3 mg/l. Concentrations of some metals can be dangerous to fish at levels as low as a few micrograms per liter (ug/l). Even small additions of these substances to the West Fork could cause acute or chronic toxicity problems. Addition of nutrients to the West Fork of the Stillwater probably would not result in a problem of toxicity; however, additional nutrients may alter the abundance and composition of aquatic organisms in the stream.

No measurable impact is expected on stream organisms, including fish, if the J-M discharge meets Water Quality Bureau permit conditions.

GEOLOGY AND SOILS

The Stillwater Complex contains one of the world's richest collections of minerals - chrome, copper, nickel, platinum, palladium, silver, gold and iron. Geologically, the area is a Precambrian layered basic and ultrabasic complex (2.7 to 3.2 billion years old), according to information from the Johns-Manville Corporation.

The complex is exposed along the northeast front of the Beartooth Mountains, and dips steeply to the north and strikes east-southeast for a length of 28 miles and a width of 4.5 miles. It is bordered on the south by a large highland area of ancient Precambrian metasediments (3.2 billion years old) and a young intrusion of granite (1.55 billion years old). The northern contact of the complex is covered unconformably by Cambrian sediments which completely mask the upper sequences of the complex. The effects of repeated tectonic movements are shown by multiple cross faulting toward basal section, while later Laramide mountain building has given rise to considerable uplift, with associated strike and thrust faulting.

In terms of soils, the Forest Service has classified soil near the adit as being in the Rock Outcrop Ecosystem. The adit is at the base of a massive rock outcrop. The road leading to the adit and the pad at the adit protal are in the Douglas fir ecosystem.

The Rock Outcrop Ecosystem is characterized as having soils which are well-drained, shallow, dark in color and gravelly. They occur on high plateaus and steep precipitous barren rock canyons. Soils of the Douglas Fir Ecosystem generally are medium in depth, and contain less rock in the surface horizons. They have a thick organic mat on the surface and are deeper and have a better developed surface horizon than soils in the Rock Outcrop Ecosystem.

Impact of the addition exploration planned by J-M will be to increase the size of the waste dump, which will impact the soil system by adding a thicker layer of waste rock and the area of the dump may be increased. Reclamation requirements of the Montana Department of State Lands are normally for grading, shaping and grassing of waste dump areas. (Personal communication, W. Criswell, State Land Department, May 18, 1976). The U. S. Forest Service, however, has primary land management responsibility and they will require the waste dump to be "shaped and blended in." No trees or grass are required. (Personal communication B. LaMoure, Custer National Forest, Billings, May 27, 1976).

VEGETATION

The Forest Service has described the vegetation around the adit as being the type associated with the Rock Outcrop ecosystem, while vegetation along the road leading to the adit has been classified as being in the Douglas Fir Ecosystem.

Rock Outcrop Ecosystem:

Tree species and understory vegetation in these pockets of soil are similar to those of the Douglas-Fir, Lodgepole Pine or Subalpine Forest Ecosystems.

Characteristic Vegetation

Douglas Fir	Pseudotsuga menziessii
Lodgepole Pine	Pinus contorta
Limber Pine	Pinus flexilis
Indian Rice Grass	Oryzopsis hymenoides
Pine Bluegrass	Poa scabrella
Bluebunch Wheatgrass	Agropyron spicatum
Skunkbrush Sumac	Rhus trilobata
Rubber Rabbitbrush	Chrysothamnus nauseosus
Holboell Rockcress	Arabis holboellii
Granite Gilia	Leptodactylon pungens

Associated Species

Alpine Fir	Abies lasiocarpa
Erigonum	Erigonum chrysops
Alpine Sandwort	Arenaria obtusiloba
Skunk Polemonium	Polemoneum viscosum
Yellowstone Draba	Draba incerta
Lance-leaf Stonecrop	Sedium lanceolata
Gooseberry-leaved Allumroot	Heuchera grossulariifolia
Yellowdot Saxifrage	Saxifraga bronchialis
Cymopterus	Cymopterus bipinnatus
Rockvine Penstemon	Penstemon elliptiucus

The species of low vegetation found in this ecosystem varies with the elevational differences. The exposure also plays a part in limiting the type of vegetation found. The lower south facing slopes become exceedingly dry and hot during the summer months.

Douglas Fir Ecosystem:

Characteristic overstory vegetation is Douglas Fir if plant succession is near climax. However, this ecosystem may support dense stands of lodgepole pine following fires. The understory may vary with regard to stage of succession and with difference in site. For example, nine-bark is more prevalent on moist sites and at lower elevations. It may be confined to northern slopes because of moisture requirements. (Daubenmire and Daubenmire, 1968). Although ninebark, snowberry, and huckleberry are the usual dominant species in the understory, the understory may also consist of pine grass, barberry, spiraea or other type variations.

Characteristic Vegetation

Douglas Fir	Pseudotsuga menziesii
Ninebark	Physocarpus malvaceus
Snowberry	Symphoricarpos alba
Heartleaf Arnica	Arnica cordifolia
Pine Grass	Calamagrostis rubescens
Thinleaved Huckleberry	Vaccinium scoparium
Low Red Huckleberry	Vaccinium scoparium
Spiraea	Spiraea betulifolia
Barberry	Berberis repens
Elk Sedge	Carex - geyeri
Kinnikinnick	Arctostaphylos uva-ursi

Associated Species

Pipsissewa	Chimaphila umbellata
Rose	Rose woodsii
Dogtooth Lily	Erythronium grandiflorum
Woodland Strawberry	Fragaria virginiana
Lupine	Lupinus sericeus
Arrowleaf Balsamroot	Balsamorrhiza sagittata
Shepherida	Sheperdia canadensis
Bluebunch Wheatgrass	Agropyron spicatum

Impacts of additional work in the J-M adit will be to cover a small additional area with rock wastes.

AIR QUALITY:

Limited air quality data has been gathered in West Fork and Stillwater River valleys during the last year, according to the Air Quality Bureau, Department of Health and Environmental Sciences. Four weather instruments have been operational since last fall and a fifth was installed in May. Fluoride and high volume sampling is now in progress. Vegetation samples have been gathered, but analysis for trace elements will not be done for several months.

Preliminary data indicates that:

1. Oxidant and carbon monoxide concentrations in the ambient air were not detectable using Mast and Ecolyzer instruments.
2. Sulfur oxide concentrations are very low (.3 $\mu g/m^3$).
3. Suspended particulate matter concentrations at the Keith E. Martin residence near Nye are about 17 $\mu g/m^3$. Data from other stations are not presently available.

HISTORICAL AND ARCHAEOLOGICAL:

Granting the permit would not impact historical or archaeological sites.

According to Lahren (1975) and the Montana Department of Fish and Game (1975), there are no known historical or archaeological sites near the adit or the base camp. Lahren did identify some primitive campsites in the western and southwestern portions of Horseman Flats, but granting a discharge permit will not effect these sites.

ENVIRONMENTAL RESOURCES

Additional exploration activity at the J-M adit will have no known additional impact on unique, endangered, fragile environmental resources in the area. The West Fork of the Stillwater River is an exceptional area and is accessible by road. Such undisturbed, high quality outdoor areas are available in limited quantities in the United States. In Montana, however, there are a number of such areas available to the public, but high quality wilderness-forest environments with high quality streams are a limited environmental resource that will sustain an additional impact from the continued exploration of the J-M Corporation.

V. IMPACT ON HUMAN ENVIRONMENT

IMPACT SUMMARY - HUMAN ENVIRONMENT

Granting of the waste discharge permit to the J-M Corporation may allow continued exploration at the adit. Impacts of this continued exploration activity (Figure 2) indicate that impacts on the human environment are minor and are associated with quantity and distribution of community and personal income, quantity and distribution of employment and industrial and commercial activity. These impacts all relate to the employment of workers at the job site if the exploration activity is continued. There will be a demand for energy if the exploration is continued and there will be a minor impact on transportation networks and traffic flows due to the increased traffic associated with continued adit development. Continuation of the exploration adit also will impact the aesthetics of the area as an additional 8,000-10,000 cubic yards of rock will be placed on the waste dump. The waste dump will be more visible than is the existing waste dump. A description of each of these impacts is included in this Preliminary Environmental Review.

SOCIAL STRUCTURES AND MORES AND CULTURAL UNIQUENESS AND DIVERSITY:

The upper Stillwater River Valley is a rural, agrarian community which embraces many traditional values of country living -- close neighborly ties, concern for character of the land and a sense of community pride. Outdoor enthusiasts frequent the area during summer and fall, but generally the area has not been significantly impacted by outside interests since the federal government subsidized chrome mining during World War II and the Korean War. This mining ended in the early 1960's. Johns-Manville's exploratory adit is the first serious mining effort in 15 years. The presence of the activity has prompted local people to band together in an attempt to retain the present life style and character of the land.

FIGURE 2

HUMAN ENVIRONMENTAL IMPACT - SUMMARY

	Major	Mod-erate	Minor	None	Un-known	Discussion on page
Social structures and mores				X		17
Cultural Uniqueness and diversity				X		17
Local and state tax base and tax revenue				X		19
Agricultural or industrial production				X		19
Human health				X		19
Quantity and distribution of community & personal income			X			19
Access to and quality of recreational and wilderness activities				X		20
Quantity and distribution of employment			X			20
Distribution and density of population and housing				X		20
Demands for government services				X		20
Industrial and commercial activity			X			20
Demands for energy			X			21
Locally adopted environmental plans and goals				X		21
Transportation networks and traffic flows			X			21
Aesthetics			X			21

If the state grants a water discharge permit to J-M there should be little change in the social/cultural situation. The first major social/cultural impact occurred when full scale exploration began December 18, 1974, and the second will occur if J-M decides to develop a mine and mill in the area.

According to a J-M official, (Tom Meiklejohn, personnel communication May 14, 1976) when exploration resumes the size of the work force, 17 persons, will not increase. Meiklejohn further stated that members of the previous crew were all from Montana and five persons live in local towns. The fact the men were Montanans, and that some live in the community, lessened the social/cultural differences which could occur if the men were from other parts of the United States. If exploration resumes, the geographic origin of workers may or may not be the same as the previous work force.

LOCAL AND STATE TAX BASE AND TAX REVENUES:

Since the operation will employ the same number of men when exploration resumes as it did when work stopped, the continuation of wages for workers will provide additional tax revenue. According to J-M (Tom Meiklejohn, personnel communication May 19, 1976) the extension would not result in an increase of personnel or equipment. An official in the Sweetgrass County Auditor's Office said J-M is being taxed for land, equipment and nine trailer homes.

AGRICULTURAL OR INDUSTRIAL PRODUCTION:

The exploration site is on federal land which is administered by the Forest Service. The land is mountainous, heavily forested and generally undesirable for agricultural pursuits. Granting a water discharge permit would not interfere with agricultural or industrial production.

HUMAN HEALTH:

If all conditions of the permit are met, there should be no impact to human health.

QUANTITY AND DISTRIBUTION OF COMMUNITY AND PERSONAL INCOME:

The communities of Nye and Absarokee and the City of Billings benefit economically from the exploratory work. J-M workers who live in Nye and Absarokee add to the economic well being of their communities by paying taxes and purchasing goods and services. Their fellow workers, although not permanent residents, also benefit local economies by buying goods and services.

According to J-M (Tom Meiklejohn, personnel communication, May 19, 1976) weekly payroll for persons working on the project is $7,000. In addition to salaries, J-M buys groceries for the persons living at the

site and fuel for equipment in Absarokee. However, in the case of the fuel, J-M owns a gasoline station in Absarokee, so the economic benefits are realized by the bulk dealership the company deals with, and not by local businesses.

J-M touches other markets in Montana by employing Montanans from other parts of the state and by buying much of its mine equipment from businesses in Billings. When exploration ceased in February, the economic benefits ceased. However, if the permit is issued and work resumes, the economic benefits will resume.

ACCESS TO AND QUALITY OF RECREATIONAL AND WILDERNESS ACTIVITIES:

A variety of recreational activities occur in the area near the adit. In addition to hunting and fishing, the area serves as a trailhead for persons hiking into the Beartooth Primitive Area. If the conditions of the permit are met, there should be no impact on the quality of recreational activities.

The activity around the adit and campsites lessens the chance of wildlife living or passing near the area which may alter hunting and wildlife observation. The corporation's interest in maintaining the road might benefit hikers and campers. An improved road means better access, which can result in an increase in the number of persons using the forest trails.

The trailhead is near the adit. The activity around the adit is not aesthetically pleasing, and possibly offends some persons. Yet, the adit site is screened from the trail and evidence of exploration -- visual or audible -- decreases as one proceeds up the trail.

QUANTITY AND DISTRIBUTION OF EMPLOYMENT:

In terms of local employment, only five persons from the area are working on the project, thus resuming work will have a minor impact on local employment.

DISTRIBUTION AND DENSITY OF POPULATION AND HOUSING:

Since J-M houses persons working away from home and the company does not plan to increase the size of the work force, there is no impact on population or housing.

DEMANDS FOR GOVERNMENT SERVICES:

There should be no demand for government services if the permit is approved. Persons from outside the community do not require local government services, and those who work for J-M and live in the area are paying taxes.

INDUSTRIAL AND COMMERCIAL ACTIVITY:

Refer to discussion of Quantity and Distribution of Community and Personal Income.

DEMANDS FOR ENERGY:

The energy demands for the project are minor. According to Meiklejohn, fuel needs for generators and compressors average about 250 gallons a day. There are no other sources of energy available at the site.

LOCALLY ADOPTED ENVIRONMENTAL PLANS AND GOALS:

If conditions of the waste discharge permit are met there should be no alteration of local plans and goals. The Summary and Social/ Cultural Impact Sections discuss these considerations. There are four local planning groups concerned with J-M's exploration and possible development. The groups are the Sweetgrass County Planning Board, Stillwater County Planning Board, Stillwater Protective Association and the Tri-County Planning Association, composed of persons from Sweetgrass, Stillwater and Carbon counties.

TRANSPORTATION NETWORKS AND TRAFFIC FLOWS:

The road to the exploration site is an unimproved gravel road. It begins at the Mouat Mine and winds more than 1,000 feet up a slope to Horseman Flats. It then heads west, descending from the flats into the West Fork Stillwater River Valley. It proceeds south past an open area in the bottom land where the J-M trailers are parked. It then winds its way up the valley. Not far from the J-M camp a newly constructed bridge crosses the river, providing access to the adit site, on the west side of the river. On the east side of the river, near the bridge there is a parking lot for the public vehicles.

Prior to shutting down operations, inert rock from the adit was screened and used to surface portions of the road. If the permit is issued, and exploration resumes, the surfacing will continue. The use of the rock on roads benefits J-M's access to the site, and makes it easier for recreationalists to drive to the Forest Service trailhead. If the permit is granted, there should be a moderate improvement to the road due to the surfacing operation.

AESTHETICS

Further adit exploration will cause additional activity in the mine area and at the mining camp in the nearby Initial Creek campground. Many recreationists will find the presence of people, vehicles and mining facilities to be aesthetically unpleasing, as it may be thought to detract from the outdoor experience. The additional 8,000 to 10,000 cubic yards of waste rock that will be placed on the dump will create a larger waste pile. This pile will be more visible from the trail head than is the present waste dump. Many people would consider the additional waste dump to be aesthetically displeasing. The waste dump, however, rapidly recedes from view as one proceeds up the trail.

VI. NEED FOR AN EIS

A major objective of the PER (Preliminary Environmental Review) is to determine whether the proposed action of the Department will have a significant impact on the human and/or physical environment. In accordance with the rule, MAC 16-2.2(2)-P2020, "If the PER shows a potential significant effect on the human environment, an EIS shall be prepared on that action". This rule further states that the following are actions which normally require preparation of an EIS;

a) the action may significantly affect environmental attributes recognized as being endangered, fragile, or in severely short supply;

b) the action may either significantly affect growth inducing or inhibiting; or

c) the action may substantially alter environmental conditions in terms of quality or availability.

In the case of Friends of the Earth, Inc., vs. Earl Butz (1975) the necessity for an Environmental Impact Statement was in question. This case involved a decision by the U. S. Forest Service not to prepare an environmental impact statement on the exploration permit granted to J-M. The case is on appeal to the Ninth Circuit Court of Appeals. Judge Battin's opinion described why it is not possible to prepare an environmental impact statement during the exploratory states of development. Based on this case and in examination of facts in the present J-M situation, there appears to be insufficient legal grounds to require the preparation of an EIS.

Impacts of the additional 3,000 feet of adit exploration on the physical environment and on the human environment is described and summarized in Sections III and IV. Although the continuation of the adit does have an impact on both the physical and human environment, it is the opinion of the Water Quality Bureau, that the impact does not constitute a significant impact.

It can be argued that the entire exploration activity of the Johns-Manville Sales Corporation on the West Fork of the Stillwater River does have a significant impact on the physical and/or human environment. This PER, however, addresses only additional impacts created by additional exploration activity at the adit. The impact of the initial adit development, although of significant interest, is not the focus of this PER and impacts from this initial development have already occurred. Only impacts that will be caused by the additional development are under consideration in this statement. This constraint in the scope of this PER is an important factor in consideration of the need for an EIS.

Based on the impact on the physical environment, the impact on the human environment and in consideration of the rules of the State, it is the opinion of the Water Quality Bureau that an EIS is not needed for the additional exploration activity planned by the Johns-Manville Sales Corporation on the West Fork of the Stillwater River.

VII. ACKNOWLEDGEMENTS FOR PREPARATION OF PER

A number of persons were involved in preparation of this PER. All sections of the PER were prepared by the Water Quality Bureau except for the following. The section on Aquatic Life and Habitats was prepared by Phil Stuart, Montana Fish and Game Department; Soils and Geology, Vegetation, and Historical and Archaeological Section by Tom Ellerhoff, Department of Health and Environmental Sciences; and Air Quality by the Air Quality Bureau, Department of Health and Environmental Sciences. The section on Impact on Human Environment was written by Tom Ellerhoff, Department of Health and Environmental Sciences. Mr. Steve Brown, Legal Division, Department of Health and Environmental Sciences, provided assistance in preparation of the Introduction and the Need for Environmental Impact Statement. Many sections include material from another source. Such sources have been referenced.

The following agencies and groups were contacted concerning the PER:

Montana Department of Fish and Game, Helena and Columbus
Montana Department of State Lands, Helena
Montana Bureau of Mines and Geology, Butte
Chemistry Department, Montana College of Mineral Science and Technology, Butte
Sweetgrass County Auditor's Office, Big Timber
Bob Noe, Stillwater County Planning Board, Columbus
U. S. Forest Service, Custer National Forest, Billings
U. S. Geological Survey, Helena
U. S. Environmental Protection Agency, Denver, Colorado
Johns-Manville Sales Corporation, Denver, Colorado
The Anaconda Company, Butte, Montana
Cementation, Inc., Tuscon, Arizona
U. S. Bureau of Reclamation, Denver, Colorado
U. S. Environmental Protection Agency, Cincinnati, Ohio
Soil Technology, Raymond International, Cherry Hill, New Jersey
Michigan Department of Natural Resources, Lansing, Michigan

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